Tenant Mix Variety in Regional Shopping Centres: Some UK Empirical Analyses

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I. Introduction

The planned shopping centre or mall has become an important part of contemporary life style. It has been changing patterns of shopping as well as social and recreational activities since its first appearance in 1920s in the US: now malls are found almost everywhere in the world (Brown, 1992; Urban Land Institute, 1999). One of the major reasons for this creation was to engineer a better shopping environment and, thus, gain better operational performance. In this created shopping environment, negative agglomeration effects can be more easily eliminated or keep under proper control, further reinforcing favourable interactions among tenants. Consequently, agglomeration economies generated from the clustering of tenants are one of the most significant benefits to be pursued by retail managers.

This cluster of tenants is referred to as the "*tenant mix*" by the shopping centre industry. It has been a long-term concern for shopping centre managers/operators and researchers in this area[1] because of its significance in establishing the shopping centre's image and enhancing the synergies within the shopping centre. However, no satisfactory suggestions have been made for the best strategy for tenant mix; owners merely followed some rules of thumb or their own experience (Anikeeff, 1996; Brown, 1991; Greenspan, 1987). Nevertheless, we know, from agglomeration theory, that variety is an important factor in increasing productivity in the traded-good sector (Fujita, 1989; Fujita and Thisse, 2002). However, there is a still lack of operational principles to advise centre managers/operators how to perform this crucial element for creating a pleasant shopping environment.

[1] See, for example, Abratt *et al*., 1985; Anikeef, 1996; Brown, 1992; Downie et al., 2002; Gerbich, 1998; Greenspan, 1987; Kirkup & Rafiq, 1994; Yuo *et al.*, 2003.

Consequently, this research attempts to reveal some information concerning beneficial patterns of tenant mix variety. A database is established for this purpose, covering the tenant lists of all regional shopping centres in the UK. A total of 148 shopping centres are included in the database for the year 2002. Three sets of tests of the beneficial patterns of tenant mix variety are conducted: *first*, given the proposition of the relationship between variety and performance (rent), five operational variety indices - size of shopping centre, number of units, average unit size, number of retail/service categories and number of brands - will be examined through econometric methods; *second*, the impact of concentration or diversity in tenant mix patterns are tested using Herfindahl indices of retail/service categories and the number of brands within each shopping centre; *third*, the value of concentration on core categories and brands is tested by a factor analysis used to extract the exact core/periphery retail/service categories from the tenant lists of the 148 regional shopping centres. The paper focuses exclusively on tenant mix variables. Prior work examined rent formation in UK shopping centres in more detail (Yuo *et al.*, 2003).

II. Literature Review

2-1 Agglomeration economies and increasing returns

Tenant mix variety is the combination of homogeneous and heterogeneous agglomeration that generates increasing returns from both scale and scope. Firms producing the same traded good can enjoy the advantages of agglomeration. "*Firms producing the same traded good may find it profitable to agglomerate …These agglomeration economies are often called (Marshallian) external economies because they are a consequence of an enlargement of the total activity level of the industry in the same city and hence are beyond the control of each individual firm*" (Fujita, 1989, pp271-272). Firms with product heterogeneity also benefit from agglomeration. Fischer and Harrington (1996, p281) thus suggested "*greater product heterogeneity increases consumer search, which raises the amount of shopping at a cluster.*" These agglomeration economies imply that the increasing returns to scale (or economies of scale) must be achieved by the firms in the cluster (McCann, 2001, p55). Return to scale is the relationship between input of resources and the outputs of the production function: increasing returns to scale implies that the outputs of the production function are greater than the scales of the inputs to the production system.

In addition to economies of scale, the advantages of agglomeration also come from scope, "*…a basic and intuitively appealing property of production: cost savings which result from the scope (rather than the scale) of the enterprise. There are economies of scope where it is less costly to combine two or more product lines in one firm than to produce them separately*" (Panzar and Willig, 1981, p268). Mainly economies of scope are generated from the sharing of inputs and costs. Benefits come from the economies of sharing in the joint production of a multiple-product. For urban economies, these economies of scope save the costs of inputs or transportation at spatial agglomeration in combining multiple-products (Goldstein and Gronberg, 1984).

2-2 Variety, productivity and the core-periphery relationship

In urban economics, variety is one of the most significant reasons for forming a city; both central place theory and agglomeration economies theory tell us that variety always plays an important role as a favourable factor in industry and commercial agglomeration. Fujita (1989, p272) suggested that "*…increasing returns to scale in the service industry and the desire of the traded-good industry to employ a variety of intermediate services may provide the basic forces of industrial agglomeration in a city; that is, the larger the variety of available intermediate services, the higher will be the productivity of the traded-good industry in a city.*" As a city needs variety, so does a shopping centre. The larger the shopping centre, the more variety it needs. The greater the variety it has, the higher the productivity it can achieve.

Consequently, clustering of retailers can generate variety and increase attraction. In retail location theory, Nelson (1958) first showed that the tendency of retail clustering is based on the theory of Cumulative Attraction and the Principle of Compatibility. In his research, the theory of cumulative attraction suggested "*…a given number of stores dealing in the same merchandise will do more business if they are located adjacent or in proximity to each other than if they are widely scattered*" (Nelson, 1958, p58). This is the major reason for retail agglomeration. This retail store spatial affinity was also observed by Getis and Getis (1976). In their research, they suggested that retail store spatial affinities are based on three location theories: the theory of land use and land value, central place theory, and the theory of tertiary activity. After examining retail stores in the CBDs of a sample of cities in the US, they confirmed that retail store spatial affinities do exist and matched them with the propositions of Central Place theory (Getis and Getis, 1976).

Krugman (1991) also makes suggestions about the beneficial patterns for agglomeration behaviour. One of the most significant patterns is the core-periphery relationship. He suggested that the agglomeration of a country has an "industrial core"- "agriculture periphery" relationship, so as to gain scale economies while, at the same time, minimising transport costs. As the agricultural product is characterized both by constant returns to scale and by intensive use of immobile land, the manufactured product is characterized by increasing returns to scale and modest use of land: "*because of economies of scale, production of each manufactured good will take place at only a limited number of sites*" (Krugman, 1991, p485).

This core-periphery relationship in agglomeration can also explain retail agglomeration in a shopping centre. Instead of manufactures, the "core" of a regional shopping centre is the agglomeration of anchors, high comparison goods and services, and the popular/fashion retail categories. The periphery, on the other hand, is the retail/service providers in a supplementary role. Therefore, the retailers locating in the "peak pitch" of pedestrian flows are the "core" stores, whilst periphery stores are usually located in the surrounding locations. Later in our empirical study, this core-periphery relationship in UK regional shopping centres will be tested in order to find out the core categories in tenant mix variety. The existence of this relationship can help to explain the importance of the image and "theme" for a centre. Only the right pattern with correct core-periphery categories can establish the right centre image for its theme.

2-3 Tenant mix variety

The shopping centre is an agglomeration of various retailers and commercial service providers within a well planed, designed and managed building or a group of buildings as a unit (ICSC, 2002; Urban Land Institution, 1999). This definition suggests the agglomeration of retail/service activities in a shopping centre is well planned and highly controlled by the centre manager/operator. Therefore, the interactive forces among tenants, that is the *inter-store externalities*, can be internalised/managed to maximise profits for the whole shopping centre (Yuo et al., 2003). This cluster of retail and service providers in shopping centres is termed the "tenant mix" (Bruwer, 1997; Downie et al., 2002; Kirkup and Rafiq, 1994). The variety of retail/service categories and brands is the result of this mixture of various tenants.

Previous research suggested that tenant mix is one of the most crucial factors in the success of a shopping centre (Abratt et al., 1985; Anikeeff, 1996). It is certainly one of the most crucial elements in establishing the image of a shopping centre. However, some managers and researchers still treat tenant mix as a "puzzle" in shopping centre management (Bruwer, 1997; Greenspan, 1987). The reason is because tenant mix seems to be an art, performed by the centre management team. A regional shopping centre[2] usually contains more than 100 retail units: thus the possible tenant mix arrangements of retail/service categories and brands are almost infinite. Since each possible mixture of tenants makes a distinctive contribution to the image of the shopping centre, how is it possible for us to identify an "ideal" or "balanced" tenant mix for a certain shopping centre? Moreover, tenant mix is not a static condition: the market changes over time, as do the customer preferences and fashion trends. Therefore, even the "ideal" condition achieved in one season or period might not be suitable for the next one. Besides, the retail industry is almost a perfectly competitive market: thus, the actions of competitors always dramatically influences marketing strategies. Consequently, centre managers/operators have to adjust their tenant mix constantly to keep up with the market trends. Under these circumstances, it is not surprising to find that an ideal tenant mix can be a puzzle for centre managers/operators.

A good tenant mix includes a variety of compatible (or complementary) retail/service providers, and an efficient space allocation (both size and number) and proper tenant placement that encourages the interchange of customers and retail activities. In a wider perspective, it should also include sufficient public facilities and services, both in terms of the quality and quantity demanded. The essentials that enhance the quality of the centre's shopping environment, to satisfy shoppers' needs, such as goods and services, convenience, excitement, and amenities, are all part of the elements of an ideal tenant mix.

[2] Here, we define a regional shopping centre as a shopping centre with over 300,000 sq ft (28,000 sq m) gross leasable area.

III. Hypotheses, data and models

3-1 Propositions and Hypotheses

Despite of the instability and volatility of tenant mix noted in the previous section, there are some principles and patterns that increase agglomeration economies from retail clustering. From the above review of agglomeration and retail literatures, three propositions about the beneficial patterns of retail/service categories can be extracted for further empirical examination.

Proposition 1: the higher the variety in categories and brands the higher the rent
First of all, the positive relationship between variety and productivity suggest that the higher the diversity in product variety, the higher the operational performance. This product variety may come from two aspects of tenant mix, the different retail/service categories and the brands within each of these categories.

Proposition 2: concentration in category but diversity in brands
The second proposition in this research is the concentration and diversity relationship. Although variety means diversity in retail/service categories and brands, there still should be a pattern in the distribution of these categories and brands. Since tenant mix plays a crucial part in establishing the image of the shopping centre, themes and attractions of image to be focused. Therefore, each shopping centre should concentrate on certain retail/service categories, focusing on its target market segmentation. This is, in effect, the core-periphery relationship proposition.

Proposition 3: concentration in core categories increases the rent.
Thirdly, from the full tenant lists of UK regional shopping centre, we should be able to extract the exact core and periphery retail/service categories. This will provide us with information as to which retail/service categories should be focused upon in a regional shopping centre. Since the regional shopping centre is near the top of the retail hierarchy, these “core categories” should be consistent with central place theory, and include categories such as comparative, luxury and durable goods.

There are a number of indices which could be used to reveal information on tenant mix variety in a shopping centre, such as the size of the centre, the number of units, the average size of units, the number of retail/service categories and the number of brands. Each of these five indices provides us some information on different aspects of tenant mix variety.

Three of these: the *size of centre*, the *number of units* and the *average unit size*; are size-oriented variables that can indirectly provide variety information linked to space capacity. The *number of retail/service categories* and the *number of brands* within the shopping centre, on the other hand, provide us with direct information on the variety of goods and services. Since variety is expected to be a positive factor with shopping centre rent, all these five variables representing these indices should be positively related to rent /sq ft. Therefore, the first hypothesis is:

H_a: *All of the five variables, namely the size of the centre, the number of units, the average size of units, the number of retail/service categories and the number of brands, are positively related to rents*

In order to test the meaning of these concentration-variety/diversity arguments in the shopping centre, we established our hypothesis for testing tenant mix variety:

H_b: *The more concentrated the retail categories, the higher the rent.*

It is necessary to establish the "core" of the agglomeration, namely the image or the theme of a shopping centre.

H_c: *The more the diversity of brands, the higher the rent.*

The customers thus have a deeper selection of similar goods to fulfil their need to compare prices and quality.

Regional shopping centres are ranked highest in retail centre hierarchies: both Christaller and Lösch showed in Central Place theory that all kinds of goods and services and other economic activities are available in the highest rank of city (or here the retail centre). Therefore, we suggest that a regional shopping centre should have all kinds of retail/service tenants. Nevertheless, these two further hypotheses propose that the agglomeration of these tenants should have a tendency for concentration in particular retail categories to establish their image and themes (the core). At the same time, the brands within each retail category should be as diverse as possible to provide a wide selection and allow for comparison of prices by customers[3].

[3] The selection and comparison provide by regional shopping centres should include all the retail goods: comparison goods, convenience goods, impulsive goods and other leisure, entertainment and commercial services. The definitions of these different retail goods see Northern (1984) and ULI (1999).

The last test of retail/service categories is to identify the "core" retail/service categories from the UK regional shopping centre database. A full tenant list of all the UK regional shopping centres formed the basis for extraction of representative factors by multivariate data analysis. These extracted factors, which contain the higher loadings on the core retail/service categories, also need to be tested in regression models to show their relationship with rent. These factors with high loadings of core retail/service categories should have a positive significant relationship with rent/ sq ft. Thus the hypothesis is suggested as:

H_d: *The higher the "core" factor scores the higher the rent.*

3-2 Data

The data collection exercise targeted all the regional shopping centres in the UK for both performance and characteristics information. In the final database, a total of 148[4] regional shopping centres meeting the definition of above 300,000 square foot were included. The database was collated from multiple sources, including Freeman's Guide (Baum, 2001), Shopping Centre and Retail Directory (William Reed Directories, 2001), and EGI's Shopping Centre Research and Market Place databases. From these sources, two linked datasets were created. The first contains detailed characteristic information for these 148 shopping centres, including the tenant lists of all the shopping centres with 11,918 detailed records of individual tenants with name, and retail category, as well as country of origin. However, the availability of individual information in terms of size of units, rental levels, and service charges is limited. The second dataset provides information on unit size and rental levels for individual units within the 148 shopping centres from different sources. In the second dataset, some 1,930 records with detailed occupier information were collected including name of occupier, rental level (total rent per annum or rent per square foot/metre), retail activities, size of tenants (measured in square foot).

All the shopping centre detailed information was collected in 2002. The tenant lists of shopping centres are dated for the period January 2002 to March 2002. Since tenant composition will change over time, setting a specific date for data collection is crucial in maintaining data quality for later analysis. However, as discussed further below, the dates of rent level data varied considerably.

[4] These 148 shopping centres are narrowed down from a total of 214 shopping centres drawn from different sources of data, by eliminating the centres that are under construction, not located in mainland Britain, or categorized as shopping/retail parks.

3-3 Models: regression models and factor analysis

3-3-1 Data adjustment and definitions

Several adjustments are needed prior to analysis. The most important adjustment is to the dependent variable, the rent variable. The rental data available was mostly recent but included earlier dates with a very small number (around 2.5%) being pre-1990. We use the following formula to adjust rents to a common 2002 date:

$$\bar{y}_i = \frac{Yit}{Si} \prod_{t_n} (1 + r_{jt_n})$$

$\bar{y}_i$: adjusted retail rent per sq ft of retail i

Y_{it} : total rent per annum of retailer i at year t.

S_i : unit size of retailer i (sq ft)

r_{jt_n} : retail rental growth rate in region j at year t_n

t_n : years from the time of occupation to year 2002

The variables used in later models are defined as Table 1:

Table1: Definitions of variables

Variables	***Description***	***Data Type***
Lnrentsqft$_i$	Logarithm of rent per square foot of the occupier retailer i.	Numerical
RRRL	The appropriate regional retail rental level in April 2002	Numerical
STenant	Strong tenants, from Freeman's Guide 2002, all top retailer/service providers in each retail categories, 1(top retailer), 0(non-top retailer)	Dummy
SCage	Shopping centre age from original opening date	Numerical
Sgrouping	Size grouping of tenants (classified as anchor, major space user, standard large, standard small, and small tenants)	Categorical
Ngrouping	Number of outlets grouping (classified as strong, medium, weak chain, and independent retailer)	Categorical
Footfalls	The average weekly footfall of the shopping centre	Numerical
SCsize	Shopping centre size in sq ft	Numerical
SCunit	Number of units in the shopping centre	Numerical
Ausize	Average unit size of each shopping centre	Numerical
NOFCATE	Number of categories in each shopping centre	Numerical
NOFBRANDS	Number of brands in each shopping centre	Numerical
C	Constant	

3-3-2 Testing the variety indices

Five variables related to tenant mix variety are examined individually: a) size of shopping centre; b) number of units within a shopping centre; c) average unit size in a shopping centre; d) number of retail/service categories within a shopping centre; and e) number of brands within a shopping centre. The related models used here are presented as Model 1 to Model 5:

Model 1: $Lnrentsqft_i = f(Sgrouping, SCsize)$

Model 2: $Lnrentsqft_i = f(Sgrouping, SCunits)$

Model 3: $Lnrentsqft_i = f(Sgrouping, Ausize)$

Model 4: $Lnrentsqft_i = f(Sgrouping, NOFCATE)$

Model 5: $Lnrentsqft_i = f(Sgrouping, NOFBRANDS)$

The major purpose for these five models is to test hypothesis H_a, showing the direction of coefficient and significance between these five variables and rent/sq ft. To focus on the tenant mix variables, the models are kept as parsimonious as possible. This is because preliminary tests show high multicollinearity problems: hence the nned to test separately. Moreover, from preliminary tests and prior work (Yuo *et al.* 2003), the size of unit for each tenant appears to be the most significant variable related to rent; therefore it is used as an adjusting variable to improve the degree of explanation in the models.

3-3-3 Testing the concentration/diversity of retail categories and brands

To test concentration/diversity issues, we established Herfindahl indeces of each shopping centre. A Herfindahl index is a measure of the concentration of the production in an industry and is calculated as the sum of the squares of market share for each firm. The major benefit of the Herfindahl index in relation to such measures as the concentration ratio is that it gives more weight to larger firms (retail categories) (AmosWeb, 2003; Wikipedia, 2003).

The Herfindahl index for retail categories is defined as:

$$G_{ci} = \sum_{cr=1}^{n} \left(\frac{E_{cr}}{E_{is}} \right)^2$$

Here

G_{ci} : The Herfindahl index for retail categories of the shopping centre i.

E_{is} : The total unit number in shopping centre i.

E_{cr} : The total unit number in retail category r.

n: total number of retail categories in the shopping centre industry

The definition of the Herfindahl index for retail/service brand names is similar; the only difference is in substituting the retail categories for retail brands.

$$G_{Bi} = \sum_{BK=1}^{m} \left(\frac{E_{BK}}{E_{is}} \right)^2$$

Here

G_{Bi} : The Herfindahl index for retail brands of shopping centre i.

E_{is} : The total unit number in shopping centre i.

E_{BK} : The total unit number in retail brands k.

m: total number of brands in shopping centre industry

In Model 6 and Model 7, our objective is to test the two Herfindahl indices, thus these two models are as follows:

Model 6:

$$Lnrentsqft_i = f(RRRL, STenant, Sgrouping, SCage, Ngrouping, Footfalls, G_{Ci})$$

Model 7:

$$Lnrentsqft_i = f(RRRL, STenant, Sgrouping, SCage, Ngrouping, Footfalls, G_{Bi})$$

In Model 6 and Model 7, more adjustment variables are used to refine the ability to explain the dependent variable ***Lnrentsqft$_i$***. These include regional retail rental level (***RRRL***) and other tenant and shopping centre characteristic variables such as the strong tenants, size of tenant, strength of chain, age of the shopping centre and the weekly footfall. The reason for separating these two indices is, once again, to avoid the multicollinearity problem.

3-3-4 The core/ periphery retail/service categories from factor analysis

In the original dataset, there are more than 90 retail categories. With so many variables at the same time, we need to use a multivariate statistical technique - factor analysis - to reduce the dimensions of these variables. Factor analysis is an exploratory statistical technique which "*addresses the problem of analysing the structure of the interrelationships (correlations) among a large number of variables (e.g., test scores, test items, questionnaire response) by defining a set of common underlying dimensions, known as factors.*" (Hair *et al*., 1998, p 90)

This test was designed by using the overall tenant list (around 12,000 records were collected) and the retail categories (around 90 categories) of each tenant in the 148 regional shopping centres. By using factor analysis (specifically, the principal component method), we should be able to extract key factors. These significant factors can be put back into our multi-regression model to reconfirm the significance of the extracted factors. The whole analysis process is described as followed:

1. The model uses the number of tenants in the 28 retail/service categories (see Table 2), generated from our 148 shopping centre database to run the factor analysis process in SAS programme.

Table 2: 28 retail/service categories after re-categorising			
1	Accessories & Jewellery	15	Leisure
2	Books, Cards & Stationery	16	Music and Video
3	Clothing - Childrenswear/babywear	17	Non-Supermarket Food Retailer
4	Clothing - Discount/value retail	18	Pets & Accessories
5	Clothing – Menswear	19	Pharmacy Health & Beauty
6	Clothing – Unisex	20	Restaurants Bars & Cafes
7	Clothing – Womenswear	21	Services - General
8	Crafts Hobbies & Toys	22	Services - Financial
9	Department , Variety, Value and Catalogue Store	23	Services - Retailing
10	Drink & CTN	24	Sports
11	Electrical & Computer Goods	25	Supermarket
12	Footwear	26	Telecommunications
13	Gifts, Antiques & Art	27	Themed Store
14	Household Goods	28	Unknown

2. By using the number of unit of each retail/service categories of each shopping centre, we can use the factor analysis based on principal component methods to identify common factors explaining variations.

3. The factors were selected using Latent Roots Criterion (Hair *et al.*, 1998, p103) which identifies those factors with Eigenvalues equal to or greater than one. The overall communality of these extracted factors should above 60 to 70 percent.

4. After the factors are extracted, we then start to define them based on the content of these factors and retail/tenant mix related theory. The factors are rotated to improve definition.

5. Finally, the scores of these factors are calculated for each centre and then put into a multiple-regression model to see if the regression results confirm hypothesis H_d.

IV Empirical results

4-1 Tenant mix variety indices

Shopping centre characteristics relating to variety, image and overall customer drawing power were examined. We tested the overall size of the shopping centre, the number of units, the average unit size, number of retail/service categories and number of brands. Each of these variables has its own meaning related to the variety of shopping centres. The hypotheses for all these five variables were that they should have a positive relationship with rent/ sq. ft., showing that more variety has a benefit to the shopping centre. Since these five variables are illustrating centre variety, we should expect them to be highly correlated and, hence, it is inappropriate to test them in the same multi-regression model due to multicollinearity. Consequently, for Models 1 to 5, we use five simplified two-variable regressions to test these five variety variables. The variable tenant size groups (***Sgrouping***) is added to the model to increase the R-square and specification of each test. ***Sgrouping*** was also tested in Model 6 and Model 7 and proved to be highly influential on tenant rent. Tenant size is also a strongly *individual tenant* characteristic; we thus expect there should be minimum multicollinearity while testing other *shopping centre* characteristic variables.

Table 3: The multi-regression results of shopping centre size								
Dependent variable LnY: Logarithm of adjusted rent per square foot								
Model 1								
Variable	*Coef*	*SE*	*t-Stat*	*Prob.*	R-sq	Ad R-sq	F-stat	Prob
Sgrouping	-0.466	0.02	-20.04	0.00				
SCsize	0.00001	0.00	11.68	0.00	0.310	0.309	407.85	0.0000
C	4.109	0.05	84.07	0.00				
Model 2								
Variable	*Coef*	*SE*	*t-Stat*	*Prob.*	R-sq	Ad R-sq	F-stat	Prob
Sgrouping	-0.456	0.02	-19.47	0.00				
SCunits	0.003	0.00	9.23	0.00	0.286	0.285	363.88	0.0000
C	4.133	0.05	79.33	0.00				
Model 3								
Variable	*Coef*	*SE*	*t-Stat*	*Prob.*	R-sq	Ad R-sq	F-stat	Prob
Sgrouping	-0.471	0.02	-20.26	0.00				
Ausize	0.00005	0.00	6.91	0.00	0.265	0.265	328.48	0.0000
C	4.157	0.06	74.11	0.00				
Model 4								
Variable	*Coef*	*SE*	*t-Stat*	*Prob.*	R-sq	Ad R-sq	F-stat	Prob
Sgrouping	-0.457	0.02	-19.38	0.00				
NOFCATE	0.007	0.00	2.84	0.00	0.253	0.252	307.52	0.0000
C	4.200	0.09	45.91	0.00				
Model 5								
Variable	*Coef*	*SE*	*t-Stat*	*Prob.*	R-sq	Ad R-sq	F-stat	Prob
Sgrouping	-0.454	0.02	-19.47	0.00				
NOFBRANDS	0.004	0.00	11.87	0.00	0.303	0.302	395.12	0.0000
C	4.056	0.05	79.77	0.00				
White Heteroskedasticity-Consistent Standard Errors & Covariance								
Sample(adjusted): 1 1924								
Included observations: 1821: Excluded observations: 103 after adjusting endpoints								

4-1-1 Shopping centre size

Table 3, Model 1 shows that the variable ***SCsize*** is positively significantly related to tenant rent per square foot (at α =1%). This implies that the larger the shopping centre, the higher the individual tenant rent. Retailers or service providers who take the spaces still have to pack their business area effectively with enough goods and services to make sufficient transactions to generate profits.

Therefore, in general, the larger the shopping centre the higher the variety and the higher the individual rent level, confirmed in Table 3. Similar results can be found in Benjamin *et al*. (1992), Sirmans and Guidry (1993), Gatzlaff *et al*. (1994) and Tay *et al*. (1999).

4-1-2 Number of units

The number of units in a shopping centre is another index for shopping centre variety. Generally speaking, the higher the number of units the higher the variety, which means the rent level is higher. In Table 3, Model 2 the coefficient for ***SCunits*** is positive significant (at α =1%) to rent/sq ft, which confirms this hypothesis. Unlike shopping centre size, the number of units of a shopping centre indicates the division of the overall space. More units normally means more variety in retail/service tenants, although some of the individual retailers may take two or more units. However, identical retailers increase competition and decrease variety thus reducing monopoly power.

Consequently, we expect the larger the number of units, the higher the tenant mix variety. Table 4 shows that the correlation coefficient between unit number and brands is very high which supports the view that the higher the unit number the more variety of brands in the shopping centre.

Table 4: Correlation coefficient between unit and brand number of UK regional shopping centres

	SC Units	Number of brands
SC Units	1	
Number of brands	0.92	1

Observations: 148

4-1-3 Average unit size

The third index for tenant mix variety is the average unit size in a shopping centre. We can interpret this variable as a characteristic of both the shopping centre and the retailer, since larger average unit size of the retailer means more space for merchandise and services. Table 3, Model 3 confirms that a larger average unit size has a positive effect on individual tenant rent. There is a trade-off between the three factors, namely the shopping centre size, unit number and average unit size. For a given shopping centre size, more units mean a smaller average unit size. Therefore, other things been equal, only the largest shopping centre can both have a high number of unit and a large average unit size.

Of course, we should also consider that the anchor tenants and major space users may take most of the spaces. Average unit size is positively significantly related (at α =1%) to rent/ sq ft suggesting that size effects dominate mix in this case.

4-1-4 Number of retail/service categories

The fourth index in this section is the absolute number of retail/service categories. Of course, the demand for variety should mean the more retail/service categories the better. The results shown in Table 3, Model 4 also confirm our hypothesis that the more retail categories in the centre, the higher the individual tenant rent/sq ft. This result does not contradict the results using the Herfindahl index of retail/service categories shown below. In contrast, it gives more information about tenant mix variety; it is better for a shopping centre to have more retail/service categories. At the same time, as we will see, the centre should concentrate on "core" retail/service categories, which leads to certain policy implications.

4-1-5 Number of brands

The fifth and last index of tenant mix variety in this section is the number of brands in a shopping centre. Certainly, the larger the number of brands the higher the variety and rent/sq ft. Table 3, Model 5 shows that number of brands is positive significant to rent/sq ft at α =1%.

4-2 Concentration and diversity - Herfindahl index of retail/service categories and brands

In the discussion on agglomeration, we suggested that there should be rules or principles of compatibility in retail agglomeration: otherwise the cluster could be more chaotic than beneficial. In our database, there are 90 retail/service categories and 3,219 different brands in all 148 UK regional shopping centres. Centre managers/operators thus face a major selection problem: how to achieve the "best" or "ideal" tenant mix? From hypothesis H_b, we suggested that the "core" of the agglomeration should be established through the concentration on certain retail/service categories. Hypothesis H_c suggested that the diversity of brands also helps to deepen the selection of merchandises and services in these categories. Therefore, to establish its core retail/service categories and also provide a wide selection in brands, a shopping centre should concentrate on dominant retail/service categories.

The results of Model 6 and Model 7 are shown in Table 5. In Model 6, the Herfindahl index of retail/service categories (G_{Ci}) is positively significantly related to rent per square foot. By contrast, the Herfindahl index of brands (G_{Bi}) is negative significant to tenant rent (both significant at α =1%).

Table 5: The multi-regression results of Herfindahl indices of categories and brands

Dependent variable LnY: Logarithm of adjusted rent per square foot

Variable	*Model 6*				*Model 7*			
	Coeffi	*SE*	*t-Stat*	*Prob.*	*Coeffi*	*SE*	*t-Stat*	*Prob.*
RRRL	0.001	0.00	3.36	0.00	0.001	0.00	3.33	0.00
STenant	-0.088	0.04	-2.32	0.02	-0.093	0.04	-2.44	0.01
SCage	-0.009	0.00	-5.87	0.00	-0.012	0.00	-7.93	0.00
Sgrouping	-0.486	0.02	-20.33	0.00	-0.475	0.02	-19.54	0.00
Ngrouping	0.151	0.02	8.19	0.00	0.156	0.02	8.50	0.00
Footfalls	0.000	0.00	9.12	0.00	0.000	0.00	8.25	0.00
G_{Ci}	5.983	1.23	4.87	0.00				
G_{Bi}					-9.390	3.19	-2.94	0.00
C	3.497	0.12	30.38	0.00	4.120	0.10	41.85	0.00
R-squared	0.41				0.40			
Adj R-squared	0.41				0.40			
F-statistic	159.06				154.31			
Prob (F-statistic)	0.000				0.000			

White Heteroskedasticity-Consistent Standard Errors & Covariance

Sample(adjusted): 1 1920

Included observations: 1615

Excluded observations: 305 after adjusting endpoints

The result from Model 6 (Table 5) means the higher the Herfindahl index of retail/service categories, the higher the rent, which implies that *more* concentration within retail/service categories can improve the rent level. The result from Model 7 (Table 5) tells us that the lower the Herfindahl index of brands the higher the rent; our interpretation of this is the more evenly spread (diverse) are the brands, the higher the rents. Both results confirmed our hypotheses H_b and H_c. Nevertheless, we have no information on which are the key retail/service categories from these regression models. Therefore, we will use factor analysis of retail/service categories to shed light on the "core" retail categories. Only by concentrating on the core retail/service categories is it possible to acquire the greatest agglomeration economies.

4-3 Factor analysis of retail/service categories

4-3-1 Extraction of representative factors

In the previous section, several effective indices for tenant mix variety were tested. However, from these variety indices, we are still unable which categories should form the core of a tenant mix strategy We need further analysis to acquire this specific information. In this section, we use tenant mix data from the 148 UK regional shopping centres and factor analysis to extract the representative dimensions of the retail/service categories.

Table 6: Factor analysis (1)-Eigenvalues of the top 10 factors

SAS Procedure: The FACTOR Procedure

Initial Factor Method: Principal Components

Prior Communality Estimates: ONE

Eigenvalues of the Correlation Matrix: Total = 28 Average = 1

	Eigenvalue	Difference	Proportion	Cumulative
1	10.9549	7.2659	0.3912	0.3912
2	3.6890	1.7292	0.1318	0.5230
3	1.9598	0.7082	0.0700	0.5930
4	1.2517	0.1564	0.0447	0.6377
5	1.0953	0.0953	0.0391	0.6768
6	1.0000	0.0283	0.0357	0.7125
7	0.9717	0.2486	0.0347	0.7472
8	0.7230	0.0756	0.0258	0.7731
9	0.6474	0.0873	0.0231	0.7962
10	0.5602	0.0194	0.0200	0.8162

Table 7: Factor analysis (2)-variance explained by each factor

Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
39.1%	13.2%	7.0%	4.5%	3.9%	3.6%

From Table 6, we can see that by using the latent roots criterion (Hair et al., 1998, p103), the first six factors have Eigenvalues equal to or greater than one, that is, more significant than a single variable. These six factors explain 71.25% of the variation in tenant mix though only Factor 1 and Factor 2 have Eigenvalues greater than 2. Table 6 and Table 7 show Factor 1 with eigenvalue 10.95 and about 40% contribution to total variance and Factor 2 with eigenvalue 3.69 and a 13.2% contribution to total variance. From these results, the first 6 factors were extracted for further analysis. However, we expect Factor 1 and 2 to be more highly representative and related to rents than other factors.

4-3-2 Extracted factor analysis and factor rotations

It is difficult for us to generate definitions and meanings of factors from the unrotated pattern. Therefore, we apply the most commonly used orthogonal rotation method, the Varimax, and another oblique method (Promax)[5] provided by SAS software to generate rotated factor patterns and loading matrixes for further interpretation of the factors. The criteria for the significance of factor loadings can be seen in Hair *et al*. (1998, p111). They suggested that when the sample size is 100 or larger (in our database, the sample size is 148), factor loadings greater than ±.30 are considered to meet the minimal level; loadings of ±.40 are considered more important; and if the loadings are ±.50 or greater, they are considered of practical significance. Thus the larger the absolute size of the factor loading, the more important the loading is in interpreting the factor matrix.

Table 8: Factor analysis (3)- Varimax rotated factor pattern (loadings)

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
Clothing - Womenswear	0.8991	0.2130	0.0950	-0.0679	0.0349	0.0412
Restaurants Bars & Cafes	0.8666	-0.0195	0.1961	0.0693	0.0334	0.1191
Clothing - Menswear	0.8521	0.1305	0.0226	-0.0560	0.2152	0.0893
Accessories & Jewellery	0.8352	0.3736	0.1485	-0.0351	-0.0152	0.0332
Gifts, Antiques & Art	0.8161	0.1580	0.1064	0.0990	-0.1005	0.1210
Clothing - Unisex	0.7882	0.0136	-0.0087	-0.0843	0.3536	-0.0392
Crafts Hobbies & Toys	0.7808	0.1878	0.3080	0.0451	-0.0369	-0.0828
Themed Store	0.6922	0.1460	-0.0700	0.2061	-0.1589	0.0897
Footwear	0.6873	0.3092	0.2727	-0.0208	0.2549	0.0414
Childrenswear/Babywear	0.6677	0.1265	0.2485	0.0176	0.3389	-0.0601
Sports Stores	0.6484	0.5202	0.1310	-0.0091	0.1486	0.1174
Department, Variety, Value and Catalogue	-0.0433	0.7809	0.2044	0.1006	0.1622	-0.0198
Telecommunications	0.4117	0.7470	0.1403	-0.1984	-0.0574	0.0256
Electrical & Computer Goods	0.3130	0.7214	-0.0475	0.2417	0.1422	0.1648
Books, Cards & Stationery	0.3613	0.6977	0.2080	0.1105	0.0621	0.0418
Pharmacy Health & Beauty	0.4642	0.5901	0.3866	0.2247	-0.0356	0.2095
Drink & CTN	0.0956	0.1059	0.7536	0.2815	0.0855	-0.0629
Non-Supermarket Food Retailer	0.4271	0.1646	0.6345	0.0751	0.1930	0.0734
Music and Video	0.3623	0.2737	0.6114	0.0020	0.0695	0.1856
Services – Retailing	0.0594	0.4066	0.5013	0.4700	0.1664	0.3582
Services – General	0.1238	0.3015	-0.0141	0.7533	0.0811	-0.1737
Leisure	0.1046	-0.1886	0.1988	0.7209	0.0837	0.3387
Supermarket	-0.2434	0.0614	0.2698	0.6926	0.1655	0.1501
Services – Financial	0.0645	0.2853	0.4288	0.4149	0.1884	0.4299
Household Goods	0.3977	0.0490	0.0749	0.3351	0.6860	-0.1015
Clothing - Discount/value retail	-0.0612	-0.0020	0.0812	0.2139	0.7290	0.1771
Pets & Accessories	0.1395	0.1165	0.0591	0.1221	0.1645	0.8477
Unknown	0.0937	0.2235	0.1237	-0.0530	0.4549	0.1199

[5] See the SAS software online help for “Proc Factor”.

Using these criteria, we can select representative variables with high loadings of each factor. Table 8 shows that by using the Varimax rotation method, the coloured (shaded) loadings of each factor are the representative variables. The factor loadings in Table 9 provide the same information for the Promax rotation. Later, we calculate the scores of Factor 1 and Factor 2 for further tests.

Table 9: Factor analysis (4)- factor structure matrix (correlations)
Promax rotation method

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
Clothing - Womenswear	0.9279	0.4442	0.2937	-0.0510	0.1226	0.1392
Accessories & Jewellery	0.8949	0.5877	0.3629	-0.0062	0.0753	0.1595
Clothing - Menswear	0.8747	0.3570	0.2338	-0.0304	0.2907	0.1724
Restaurants Bars & Cafes	0.8705	0.2475	0.3662	0.0891	0.1388	0.2249
Gifts, Antiques & Art	0.8326	0.3825	0.2983	0.1082	-0.0014	0.2252
Crafts Hobbies & Toys	0.8219	0.4205	0.4556	0.0652	0.0700	0.0638
Clothing - Unisex	0.7944	0.2222	0.1644	-0.0696	0.4166	0.0293
Footwear	0.7722	0.5271	0.4776	0.0469	0.3381	0.1923
Sports Stores	0.7502	0.6937	0.3820	0.0550	0.2196	0.2574
Childrenswear/babywear	0.7221	0.3457	0.4163	0.0666	0.4217	0.0793
Themed Store	0.6861	0.3129	0.1151	0.1853	-0.0729	0.1679
Telecommunications	0.5402	0.8187	0.3241	-0.1390	-0.0244	0.1347
Books, Cards & Stationery	0.5001	0.8000	0.4360	0.1823	0.1264	0.2166
Electrical & Computer Goods	0.4404	0.7909	0.2451	0.3043	0.1937	0.3157
Department, Variety, Value and Catalogue	0.1238	0.7770	0.3803	0.1880	0.1853	0.1434
Pharmacy Health & Beauty	0.6006	0.7674	0.6270	0.3154	0.0638	0.4169
Drink & CTN	0.1967	0.2681	0.7861	0.3707	0.1830	0.1552
Non-Supermarket Food Retailer	0.5291	0.3892	0.7479	0.1767	0.2889	0.2650
Music and Video	0.4767	0.4679	0.7252	0.1117	0.1502	0.3550
Services - Retailing	0.2069	0.5497	0.7103	0.6001	0.2563	0.5851
Services - Financial	0.1873	0.4268	0.6228	0.5393	0.2658	0.6169
Leisure	0.1120	-0.0406	0.3403	0.7603	0.1807	0.4789
Supermarket	-0.1785	0.1095	0.3753	0.7511	0.2328	0.3189
Services – General	0.1740	0.3596	0.1808	0.7427	0.1745	0.0207
Household Goods	0.4514	0.2152	0.2828	0.3850	0.7584	0.0599
Clothing - Discount/value retail	0.0074	0.0657	0.2213	0.3070	0.7402	0.2677
Pets & Accessories	0.2037	0.2327	0.2672	0.2397	0.1844	0.8768
Unknown	0.1789	0.2866	0.2475	0.0307	0.4612	0.1936

4-3-3 Definitions of the factors

The next step in factor analysis is to define and name the extracted factors based on the factor loadings. This procedure relies on the researchers' own interpretation. Both Varimax and Promax methods gave consistent results. Variables with higher loadings are most important in labelling a factor – they lie closest to the rotated factor in multidimensional variance space. Table 10 provides labels and interpretations for the six factors rotated.

Table 10: Factor analysis (5)- the labelling process of the factors		
Factor 1: Fashion and Comparison Variety		
Representative retail/service categories	Loadings	
	Varimax	Promax
Clothing – Womenswear	0.90	0.93
Restaurants Bars & Cafes	0.87	0.87
Clothing – Menswear	0.85	0.87
Accessories & Jewellery	0.84	0.89
Gifts, Antiques & Art	0.82	0.83
Clothing – Unisex	0.79	0.79
Crafts Hobbies & Toys	0.78	0.82
Themed Store	0.69	0.69
Footwear	0.69	0.77
Clothing – Childrenswear/babywear	0.67	0.72
Sports	0.65	0.75
Factor 2: **Selective Goods, Information and Health**		
Representative retail/service categories	Varimax	Promax
Department, Variety, Value and Catalogue Store	0.78	0.78
Telecommunications	0.75	0.82
Electrical & Computer Goods	0.72	0.79
Books, Cards & Stationery	0.70	0.80
Pharmacy Health & Beauty	0.59	0.77
Factor 3: **Supportive and Fun**		
Representative retail/service categories	Varimax	Promax
Drink & CTN	0.75	0.79
Non-Supermarket Food Retailer	0.63	0.75
Music and Video	0.61	0.73
Services – Retailing	0.50	0.71
Services – Financial		0.62
Factor 4: Leisure, Services and Daily Needs		
Representative retail/service categories	Varimax	Promax
Services – General	0.75	0.74
Leisure	0.72	0.76
Supermarket	0.69	0.75
Services – Financial	0.41	
Factor 5: Value and Household		
Representative retail/service categories	Varimax	Promax
Household Goods	0.69	0.76
Clothing - Discount/value retail	0.73	0.74
Factor 6: Others (Pets)		
Representative retail/service categories	Varimax	Promax
Pets & Accessories	0.85	0.88

The result of the representative variables for Factor 1 is consistent with both Varimax and Promax procedures, although the ranking of some of the loadings is slightly different. These factor patterns show that the "core" retail/service categories of the tenant mix in UK regional centres are mainly fashion (clothing for women, menswear and childrenswear, accessories and jewellery, and themed stores), and other comparative goods (gifts, antiques, arts, toys, footwear and sports goods). This factor

contributes 40% of the total variance, the highest of all factors. Therefore, we labelled Factor 1 as "*Fashion, and Comparison Variety*". There are also high factor loadings for dining/refreshments (restaurants, bars and cafés) which may be linked to the size of outlet. These retail/service categories fulfil the main purpose for the shoppers in regional shopping centres. To some extent, the first factor in a rotation tends to pick up "greatest" source of variation in the dataset. Thus this factor represents the core elements of the representative shopping centre.

Factor 2 is the factor with the second highest eigenvalue (3.69) and contributes 13.1% of the total variance. Although these two values are both far lower than Factor 1, Factor 2 is more significant in terms of variance than the later factors (Factor 3 contributes only 7% of the variance and other later Factors less than 5%). The representative variables in Factor 2 are selective goods (large stores: department stores, variety, value and catalogue stores), information goods (telecommunication, electrical and computer goods, books, cards and stationary), and health (pharmacy health and beauty). Here, we name this factor as "*Selective Goods, Information and Health*"

The representative variables of Factor 3 are supportive goods (drink & CTN, non-supermarket food, services – retailing, service-financial[6]) and fun (music and video). We labelled Factor 3 "*Supportive and Fun*". However, we note that the eigenvalue of Factor 3 is only 1.96 and contributes only 7% of the total variance. Although still above the criterion of factor selection (eigenvalue above 1), it is far lower than the contribution made by Factor 1 and Factor 2. Thus we decided that the factors after Factor 3 are not "core" factors for analysis of tenant mix variety.

Factor 4 is related to the retail/service categories of leisure (leisure), services (services – general, services - finance) and daily needs (supermarket) - "*Leisure, Services and Daily Needs*" The eigenvalue of this factor is only 1.25 and makes less than 5% (4.47%) contribution to explaining overall variance.

Factor 3 and Factor 4 are opposite retail/service categories to Factor 1 and Factor 2. The categories in Factor 1 and Factor 2 are the "core" of the shopping centre retail agglomeration and focus on "comparative goods", Factor 3 and Factor 4 are more "peripheral" to the centre (although weaker centres might be dominated by such

[6] Service financial is the only variable for which we can not decide the exact location, for the loadings are close in Varimax method, it could be placed in either Factor 3, 4 or 6. But it is clear that in Promax method, it is in Factor 4, though the loading is very weak (around 0.15-0.2 in Promax) so it is clearly not a major explanatory category.

outlets) and are dominated by “convenience goods” and lower order functions.
Factor 5 and Factor 6 both contribute only around 4% (3.9% for Factor 5 and 3.5% for Factor 6) of the total variance. The representative variables of Factor 5 are value (clothing – discount/value retail) and household (household goods). We labelled this factor “*Value and Household*”. Factor 6 has only one representative category, which is the pets and accessories. This is a rather weak factor and so we simply named it as “*Others (Pets)”*. The last factor in a rotation tends to clean up the remaining variation, with many low loadings so it would be misleading to over-interpret such a factor.

4-3-4 Multi-regression results with the factor scores

Factors 1 and 2 are the “core” factors from the above factor analysis. We calculate the factor scores of Factor 1 and Factor 2 from all three methods and test their relationship with rent/sq ft. The prior hypothesis is these two core factors with higher loadings at their representative variables should show a positive relationship with the performance index, i.e. the rent. A shopping centre with greater weight on these two factors can have better performance – which should be reflected in individual tenancy rents. In other words, if the tenant mix strategies of a shopping centre concentrate on these “core” retail/service categories, such centres can have a higher performance than the others.

The results from Table 11 show that the factor score of Factor 1 from all three methods (even the original unrotated factor patterns from the principal component method) gives us a positive significant relationship (at α =1%) with rent/sq ft. This means that the higher the score of Factor 1, the higher the rents, consistent with our prior hypothesis.

Table 11: Factor analysis (6) -the multi-regression results of Factor 1

Dependent variable LnY: logarithm of adjusted rent per square foot

	Principal component				*Varimax*				*Promax*			
Variable	*Coeff*	*SE*	*t-Stat*	*Prob.*	*Coeff*	*SE*	*t-Stat*	*Prob.*	*Coeff*	*SE*	*t-Stat*	*Prob.*
Sgrouping	-0.453	0.02	-19.52	0.00	-0.453	0.02	-19.65	0.00	-0.454	0.02	-19.75	0.00
FACTOR 1	0.006	0.00	13.46	0.00	0.008	0.00	15.12	0.00	0.009	0.00	15.52	0.00
C	4.044	0.05	82.42	0.00	4.055	0.05	86.80	0.00	4.083	0.05	89.63	0.00
R-squared	0.315				0.332				0.337			
Adj R-squared	0.315				0.331				0.337			
F-statistic	418.91				450.81				462.691			
Prob(F-stat)	0.0000				0.0000				0.0000			

White Heteroskedasticity-Consistent Standard Errors & Covariance

Sample(adjusted): 1 1924

Included observations: 1821

Excluded observations: 103

The variable Factor 2 also gives a positive significant result (Table 12) using the Varimax and Promax method although the result from the unrotated principal component solution is not significant.

Table 12: Factor analysis (7)-the multi-regression results of Factor2

Dependent variable LnY: logarithm of adjusted rent per square foot

	Principal component				Varimax				Promax			
Variable	Coeff	SE	t-Stat	Prob.	Coeff	SE	t-Stat	Prob.	Coeff	SE	t-Stat	Prob.
Sgrouping	-0.455	0.02	-20.09	0.00	-0.453	0.02	-19.34	0.00	-0.454	0.02	-19.35	0.00
FACTOR 2	-0.029	0.00	-18.58	0.00	0.013	0.00	10.06	0.00	0.014	0.00	7.21	0.00
C	4.399	0.04	110.8	0.00	4.038	0.05	73.54	0.00	4.124	0.06	71.76	0.00
R-squared	0.315				0.294				0.275			
Adj R-squared	0.315				0.293				0.274			
F-statistic	418.91				378.25				344.362			
Prob(F-stat)	0.0000				0.0000				0.0000			
White Heteroskedasticity-Consistent Standard Errors & Covariance												
Sample(adjusted): 1 1924												
Included observations: 1821												
Excluded observations: 103												

Collinearity problem is the major reason for reducing the variables in Table 11 and Table 12 when testing Factor 1 and Factor 2. Since the purpose here is to show that Factor 1 and Factor 2 are positive significant to rent, improving the r-square of the models are not our major concern. We should note that including a fuller specification of rental determinants weakens the significance of Factor 2. However, Factor 1 is consistently positive and significant in a wide range of model specifications, confirming its significance in explaining tenant rent.

V. Implications

From our empirical results of tenant mix variety and factor analysis of retail categories we can extract some general principles for tenant mix strategies to distinguish the better tenant mix strategy for shopping centres. We confirmed the following results:

A. The larger the shopping centre, the higher the rent (Model 1).
B. The more units the shopping centre has, the higher the rent (Model 2).
C. The larger the average unit size, the higher the rent (Model 3).
D. The more retail categories, the higher the rent (Model 4).
E. The more brands, the higher the rent (Model 5).

F. The more concentration in retail/service categories, the higher the rent (Model 6).
G. The more diversity (evenly spread) the brands, the higher the rent (Model 7).
H. The higher the scores on core factors with high loadings in the core categories, here Factor 1 (Fashion and Comparison Variety) and Factor 2 (Selective, Information and Health), the higher the rent.

The beneficial impact of tenant mix variety is the major concern of this paper. Three major aspects can be identified from the above empirical results:

1. Confirmation of increasing returns from higher variety

The above results A, B, C, D and E suggest that: the larger shopping centres with the greater number of units, larger average unit size and greater number of retail/service categories and brands are able to achieve higher rents.

2. Concentration but diversity

For the product variety, two sub-principles are suggested based on results D, E, F and G:

I Concentrate on the core retail/service categories but including as many categories (peripheral) as possible

II Emphasise diversity in brands

Rule I is the general principle of agglomeration for retail/service categories to generate higher agglomeration economies. It is derived from both the empirical results that the higher the Herfindahl index of retail categories, the higher the rent and also that the more retail/service categories in a shopping centre, the higher the rent. It tells us that a shopping centre should have as many retail/service categories as possible; nevertheless, the agglomeration of these retail categories should be as concentrated as possible.

Rule B, on the other hand, tells us the more diversity in *brands* the better. In this way, a shopping centre increases its depth of merchandise and services to the customers, i.e. for a certain retail/service category the customers have more comparative variety and

selection from different retailers and service providers.

3. The core and periphery retail/service categories

Although the results point to the existence of a core-peripheral relationship in the retail agglomeration, operationally centre managers/operators of regional shopping centres need to know exactly which retail/service categories should be included in the "core". This is shown in the results from factor analysis.

The representative retail/service categories in Factor 1 (the Fashion and Comparison Variety factor) and Factor 2 (the Selective, Information and Health factor) are identified as "core" categories; other retail/service uses could be seen as "peripheral" categories. Factor 1, in particular, is significantly positively related to rent.

Nevertheless, the tenant mix strategy remains an "art of marketing". The foregoing dies not suggest that tenant mix strategy of a regional shopping centre should be to solely concentrate on the categories in Factor 1. The empirical results showed that, with higher concentration in Factor 1 and 2 shopping centres can generate higher rents. However, while including other decision-making elements, a centre manager/operator can always have his/her reasons to alter the mix to target a particular niche market. A shopping centre can be successful if it correctly designed and implemented with concentration on other non-Factor 1 categories, including an element of leisure and entertainment. This last has been increasing in importance, though reported profit margins are not as high as the other core categories in Factor 1.

Further, the individual categories found in Factor 1 (the Fashion and Comparison Variety) and Factor 2 (the Selective, Information and Health) are UK based and may be unstable and evolve over time. The rank of the detailed categories might alter slightly in different parts of the world like the US or the Far East area, requiring further, local, research. Nonetheless, these two factors are the essentials of a "regional" shopping centre. This is exactly the notion of Central Place theory, that for the centre of a region (the highest hierarchy), it should contain the highest rank of goods and services (the fashion and comparative variety).

VI Conclusion

A regional shopping centre is meant to fulfil consumers' needs in a region. Consequently it should contain the highest product variety demanded from convenience goods to comparative goods. This variety of the retail agglomeration plays a crucial part in increasing productivity. However, variety is not merely the diversity of product combinations but should include certain principles to maximize the favourable effects that generate increasing returns. In a shopping centre, product variety comes from the combination of retail/service tenants - the tenant mix strategies that are adopted by the manager/operator. Without operational rules, tenant mix decision-making of normally follows a "rule of thumb" or experienced common sense. Therefore, the major aim of this research is to search for beneficial patterns of tenant mix .

The empirical results reveal some of the beneficial patterns of tenant mix. First, the relationship between variety and productivity is confirmed. The five variety-related indices (size of shopping centre, number of units, average unit size, the number of retail/service categories and the number of brands) are all positively related to individual tenant rent. Secondly, the distribution of the retail/service categories should be concentrated on the core categories but with as much variety in categories as possible. At the same time, the higher the diversity of brand names, the greater the contribution to rental level . Third, the core retail/service categories in a regional shopping centre: are Fashion and Comparison Goods and Selective, Information and Health outlets. Regional shopping centres that have a strong concentration in these areas – in particular on the former - generate relatively higher rents.

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